Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences
Central and Arctic Region
Canadian Science Advisory Secretariat
Science Advisory Report 2012/045

ASSESSMENT OF BUFFALO RIVER INCONNU (*STENODUS LEUCICHTHYS*) GREAT SLAVE LAKE, NORTHWEST TERRITORIES, 1945-2009

Inconnu Stenodus leucichthys
Photo by Melanie VanGerwen-Toyne

Figure 1. Map of Great Slave Lake, indicating Buffalo River.

Context

Historically, Inconnu in Great Slave Lake (GSL) have been targeted in a commercial fishery, but in recent decades Inconnu are captured as bycatch in the Lake Whitefish commercial fishery. Data suggest that the Buffalo River stock of Inconnu was harvested in large quantities in the late 1970s; after which the harvest declined dramatically and has not recovered. Fisheries and Aquaculture Management initiated a series of closure zones in space and time to help preserve the Inconnu stock. Further, the effort in the commercial Lake Whitefish fishery has declined in the last decade with the closure of three of the four fish processing plants in the area. Both of these are encouraging for the Inconnu stock. Harvest records from the commercial fishery, and research results from tagging and sampling studies have indicated that the stock has shown small signs of improvement. However, in the last few years the Inconnu stock has once again declined and remains in the Critical Zone of the Precautionary Approach framework.

Fisheries and Aquaculture Management, Central and Arctic Region, requested science advice on the status of the Buffalo River Inconnu stock, whether current management actions (closure zones) are effective, and where future research needs are required. A peer review meeting was held to address these questions.

March 2013

Canada

SUMMARY

- Inconnu are caught primarily as bycatch in the Lake Whitefish fishery in Great Slave Lake (GSL), which has operated since 1945.
- Harvest targeting Inconnu has occurred at the mouth of the Buffalo River in some years, especially in the late 1970s.
- Annual harvest has varied from a high in 1948-1949 of 163,000 kg per year to current levels of approximately 13,000 kg.
- The south-shore of management Area IE is an important zone for Buffalo River Inconnu.
- After harvest targeted Inconnu in the late 1970s, harvests decreased dramatically, biological parameters showed significant signs of negative impacts and Catch-Per-Unit-Effort (CPUE) dropped. Since then there have been periodic signs of improvement when harvests were lowest.
- The stock is currently in the Critical Zone of the Precautionary Approach model framework based on CPUE of mature female Inconnu as an index of spawning stock biomass (SSB).
- Biomass removal of >10,000 kg while the stock is below the limit reference point is expected to result in a high risk that the stock will remain in the Critical Zone.
- Fishing closures have been implemented in GSL west basin resulting in reduced Inconnu harvest in specific areas but not in the total harvest from the west basin.
- Further recommendations for closure zones based on risk to the Inconnu stock are presented.

INTRODUCTION

The Buffalo River drains Buffalo Lake and empties into GSL 40 km east of Hay River (Figure 1). Buffalo River drains an area of 17,638 km^2 and is generally swift and shallow with water depths reaching a maximum of 2.0 m in the main channel during the spring run-off period.

A commercial fishery has operated on GSL since 1945 using bottom-set gillnets (Rawson 1947). At present, the lake is divided into seven management areas in GSL (IE, IW, II, III, IV, V, VI, Figure 2); for which the boundaries have remained more or less fixed since 1972. Lake Whitefish is the target species and Inconnu is normally a bycatch species, but some targeting has occurred. Historically, there have been up to four fish plants open on GSL but only one remained open in 2009, and since 2006-2007 it has only been opened in the summer months.

Inconnu is a large-bodied member of the whitefish family (subfamily coregoninae). In GSL, they are usually found in inshore areas of the main body of the lake, except in fall when rivers are ascended for spawning. In spring, Inconnu congregate at the mouth of the Buffalo River, to feed on small fish coming out of the river (Larken, MS cited in Fuller 1955).

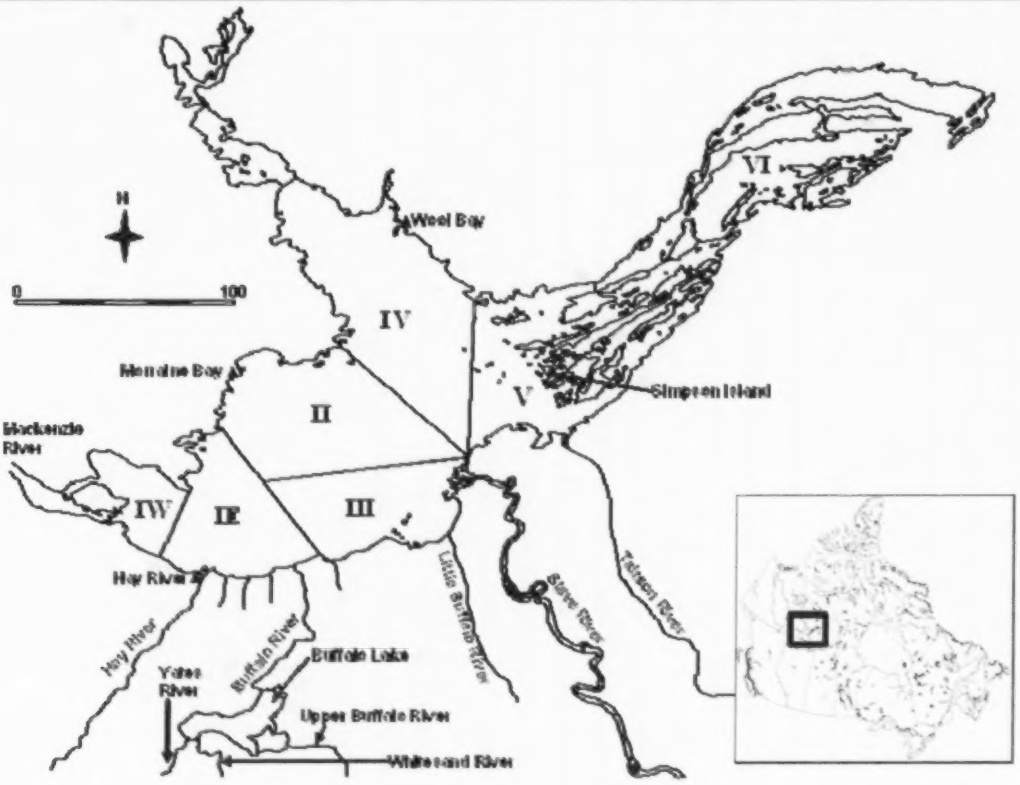

Figure 2. Map of Great Slave Lake showing management areas.

ASSESSMENT

Commercial Harvest Trends

A total of 2,204,812 kg (round weight) of Inconnu have been removed from GSL in the commercial fishery since its inception; the majority of which have come from management Area IE (818,738, 37%). Total annual harvests ranged from a high of 163,000 kg in 1948-1949 to a minimum of 10,156 kg in 2007-2008. Targeting of Inconnu occurred in 1977-1978 and 1978-1979, when the total annual harvest averaged 152,966 kg +/- 450 kg; of which 87,405 kg +/- 3,698 kg were from Area IE (Figure 3). These harvests suggest that it was the Buffalo River Inconnu stock (located in Area IE) that were most affected by the targeting. Since this time, harvests of Inconnu have decreased due to reduced

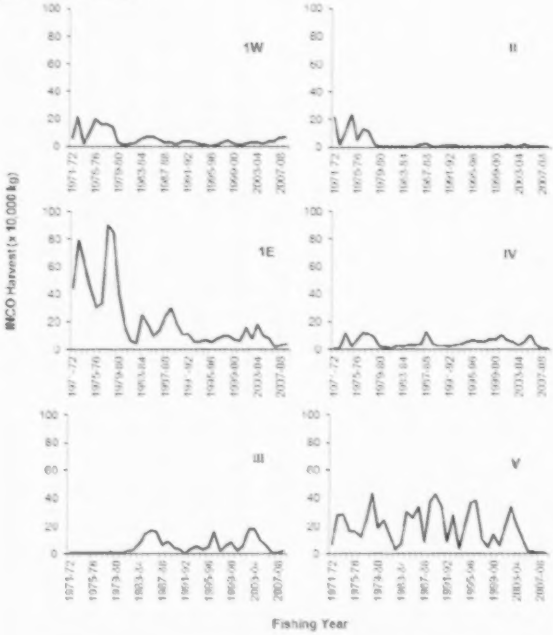

Figure 3. Annual (fishing year) harvest of Inconnu in each management area of Great Slave Lake from 1971-1972 to 2008-2009.

stock size, non-targeting, closure zones, and decreased effort. In 2008-2009, the total annual harvest was 13,141 kg.

Inconnu Distribution

Between 1995 and 2008, Inconnu have been marked with T-bar anchor tags in or near the Slave River and at the mouth of the Buffalo River, and the return of marked fish occurred primarily from the commercial fishery. The majority of recaptured fish tagged at the Slave River sites were caught in management Area V, while the majority of the recaptured fish tagged at Buffalo River were caught along the south shore of the west basin (IE, IW, II, and III) or the rivers along the west basin (Hay River, Little Buffalo River). Further, a fishery-independent harvest study was initiated in 2009 in GSL Area IE and Inconnu were captured almost exclusively along the south shore. These results demonstrate the importance of the south shore of the west basin for Buffalo River Inconnu.

Stock Status

A gillnet sampling program was conducted in varying years between 1947 and 2008 at the mouth of the Buffalo River in the spring (May-June). All biological parameters as well as CPUE showed a pronounced negative impact after the high harvests in 1977-78 and 1978-1979. The percentage of older/larger fish declined, the mean size-at-age decreased, the number of mature individuals decreased, and CPUE decreased. Further, evidence of recruitment failure is demonstrated in the age-frequency distribution:

In 1979, the eight year old cohort represented the largest portion of the catch. By 1983, this cohort was no longer represented in the catch, but its direct offspring (spawned in 1979) was evident as a cohort of four year old fish. From 1984 through 1987, this cohort dominated (Figure 4) and few young fish were seen until 1987. This pattern suggests that recruitment failure had occurred due to high harvests in 1978 and 1979, but it is also possible that it constitutes an important survival event as well.

After the dramatic declines in biological and CPUE parameters, there were periods of improvements, when harvests were lowest, but none of the parameters have since reached original status.

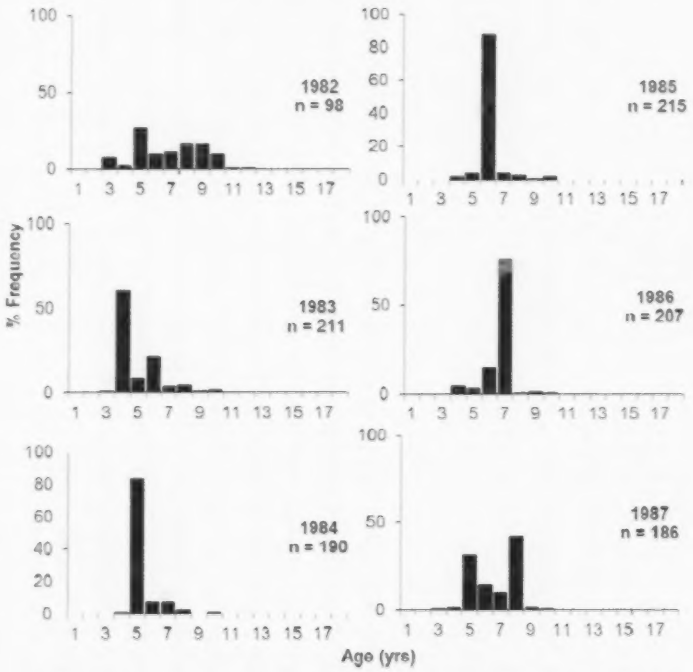

Figure 4. Age-frequency distribution for Inconnu caught at the mouth of the Buffalo River in Great Slave Lake from 1982 to 1987.

Management Recommendations

Precautionary Approach Model

Relative abundance of the spawning stock biomass, as shown in the average annual CPUE of mature female Inconnu, was used to set the limit reference points for the Precautionary Approach (PA) model for Buffalo River Inconnu. The upper stock status reference point was set at 10 mature female Inconnu per hour per net because this is the mean of this variable for the period prior to high harvests in the late 1970s and thus represents a healthy stock. The lower stock status reference point was set at two Inconnu per hour per net because it represented a decrease of 80% of the healthy stock and was therefore, qualitatively, deemed as excessive. CPUE of mature females has been less than two since 1983, except in 2003.

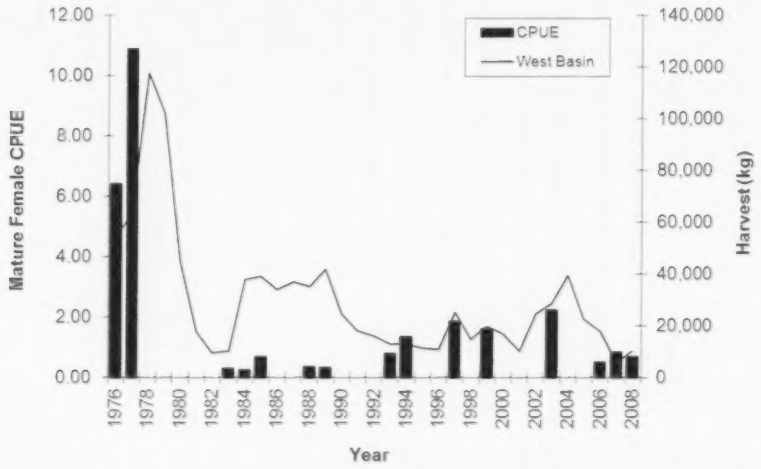

Figure 5. Annual harvest of Inconnu from the west basin overlaid on catch-per-unit-effort of mature female Inconnu caught at the mouth of the Buffalo River in GSL from 1976-2008. The solid horizontal line marks 10,000 kg harvest.

The removal reference rate for the upper stock status was set at 40,000 kg of Inconnu from the west basin because it was the annual mean harvest (48,500 kg rounded down to 40,000 kg) of Area IE (where Buffalo River Inconnu are most vulnerable) prior to abrupt stock decline and thus represent a healthy stock. A range of risk options was presented for the lower removal reference rate. A harvest greater than 10,000 kg of Inconnu in the west basin was deemed to pose a high risk to the stock because when west basin harvests were consistently above this rate, CPUE did not improve (Figure 5).

Closure Zones

To protect the Buffalo River Inconnu stock, various spatial and temporal closures to the commercial fishery were instituted and expanded by DFO Fisheries and Aquaculture Management. Harvest of Inconnu was successfully reduced in closed areas; however, the overall harvest of Inconnu in the west basin did not decrease. Further recommendations based on risk to the stock were presented as follows:

- Low Risk: close fishery on GSL west basin
- Moderate-Low Risk: close south shore year round and extend closure into Areas IW and V.

- Moderate Risk: close south shore from March 1 to Nov 1 and extend into Areas IW and V
- Moderate-High Risk: closures as set in 2008
- High Risk: closures as set in 2005

Fisheries Management reported that it was initiating a log-book program in the 2010 fishing season. This will potentially improve information of the efficiency of closure zones and will be reviewed as the information becomes available.

Recommendations for Future Research

1) Fishery Independent Harvest Study

This program provided useful information for the assessment of Inconnu in GSL and the research program should continue, but with slight modifications to better mimic the commercial fishery. It was also suggested that there may be a vertical delineation between Lake Whitefish and Inconnu and that this should be explored.

2) Spring sampling at the mouth of Buffalo River

This program was considered to be very valuable by the RAP participants, but it is also very expensive to run. Therefore, it was recommended that the program be continued as often as financially feasible, but at least every three years.

3) Genetic stock delineation

Some genetic samples have been archived but not yet analyzed. It was recommended that additional ("pure") samples be collected and all samples analyzed.

4) Radio-telemetry

Potential knowledge gain via a radio-telemetry program was recognized, but placed at a lower priority than the above three programs.

Sources of Uncertainty

- The contribution of BRI and Slave River Inconnu (and potentially others) to west basin harvests are unknown.
- The harvests from sources other than the commercial fishery (i.e., sport, domestic, subsistence, etc.) are not well known.
- Estimates of recruitment and information on the factors influencing production are unknown.
- The Upper stock reference assumes that carrying capacity is stable.
- Quantitative information on commercial fishing effort is unknown.
- Ecosystem effects on the population dynamics of BRI are unknown.
- Locations and characteristics of Inconnu spawning habitat in the Buffalo River are unknown.
- Scales were used to estimate ages. This method has been shown to underestimate age of Inconnu over 10 years old (Howland et al. 2004); thus the interpretation of age-related results should be cautious.

CONCLUSIONS AND ADVICE

The Buffalo River Inconnu stock has been depleted historically and remains at low levels. High harvests in the late 1970s resulted in a pronounced negative impact to harvest number, biological parameters, and CPUE. Small signs of improvement in the stock status were observed when harvests were low for many consecutive years, but decreased again when harvests rose. The stock is in the critical zone of the Precautionary Approach model and if the harvest of Inconnu in the west basin of GSL exceeds 10,000 kg, there is a high risk that the stock will remain in the critical zone. Efforts have been made to protect the stock through implementation of closure zones and, while they have been successful at reducing harvest in areas applied, the total harvest in the west basin remained above 10,000 kg in 2008-2009. Further closure zones and additional research have been recommended.

OTHER CONSIDERATIONS

Potential anthropogenic disturbance, changing environmental conditions, and fish health concerns were identified for the Buffalo River and GSL systems, including the following:

- Potential impacts of the Pine Point Mine on GSL and Buffalo River habitats and fish populations.
- Changing water levels in recent years which may impact the utility/efficiency of closure zones.
- Increasing sewage discharge and potential leaking from waste disposal sites into GSL.
- Recent observations that the condition of Inconnu caught at the mouth of the Buffalo River appears lower compared to Inconnu caught in the Slave River.

There is an interest in eco-certification for GSL fisheries which would be supported by scientific research to increase knowledge of Inconnu on a larger (ecosystem) scale.

SOURCES OF INFORMATION

This Science Advisory Report is from the March 30-31, 2010 Buffalo River Inconnu Stock Assessment. Additional publications from this process will be posted as they become available on the Fisheries and Oceans Canada Science Advisory Schedule at www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

Day, A.C., VanGerwen-Toyne, M., and Tallman, R.F. 2012. A risk-based decision-making framework for Buffalo River Inconnu (*Stenodus leucichthys*) that incorporates the Precautionary Approach. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/070. iv + 13 p.

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FOR MORE INFORMATION

Contact: Ross Tallman
Fisheries and Oceans Canada
501 University Crescent
Winnipeg, MB.
R3T 2N6

Tel: 204-983-3362

Fax: 204-984-2403

Mail: Ross.Tallman@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice (CSA)
Central and Arctic Region
Fisheries and Oceans Canada
501 University Crescent
Winnipeg, MB
R3T 2N6

Telephone: (204) 983-5131
E-Mail: xcna-csa-cas@dfo-mpo.gc.ca
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